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Direct and indirect effect of various traits on seed cotton yield in single, double and three way cross derivatives in upland cotton (*Gossypium hirsutum* L)

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Abstract : Correlation and path analysis were studied in 62 single cross, 46 double cross and 7 three way cross derivatives (F_4/F_5) in upland cotton (*Gossypium hirsutum* L.). These lines were developed involving hybrids picked up from the All India Coordinated Cotton Improvement Project and 15 yield and yield contributing traits were studied at Agricultural Research Station, Dharwad. Association analysis across genotypes revealed highly significant positive correlation for seed cotton yield/plant with bolls/plant, boll weight, monopodia, inter boll distance, stem dia, lint index, ginning outturn whereas, halo length, plant height, nodes, sympodial length at 50 per cent plant height showed significant negative correlation. Path analysis revealed high positive direct effect of monopodia, sympodia, inter boll distance, boll and lint index on seed cotton yield. Selection based on these characters would improve seed cotton yield. However, differences in individual traits were observed for indirect effects on seed cotton yield/plant. Highly negative direct effect on seed cotton yield/plant was observed for plant height , sympodial length at 50 per cent, plant height, nodes, boll weight, stem dia, ginning outturn and halo length.

Key words: Character association, *Gossypium hirsutum* , path analysis

The foundations of a crop improvement programme lie in the amount of genetic variability available. Such generated lines constitute the new variability and these lines if found diverse enough can also be selected as parents of hybrids. Thus, genetic diversity played a key role in analysing the general distance among genotypes to be selected as parents. Within a certain limit, hybridization of more divergent parents is expected to enhance the level of heterosis in hybrids and release of wide range of variability in segregating generations. The present investigation was undertaken to study the nature and magnitude of contribution of different characters towards yield in 62 single cross, 42 double cross and 7 three way cross derived lines under rainfed conditions.

The study was conducted at the Agricultural Research Station, University of Agricultural Sciences, Dharwad. The experimental material comprised of progeny 4 and 5 slight up, not to mix with the under line rows in F_4 /F_5 generations. The material was generated by crossing diverse hybrids indentified during 2005-2006 in the All India Coordinated Cotton Improvement Project (Table 1). The material consisted of 62 single cross, 46 double cross and 7 three way cross (Table 2) derived lines which were planted in augmented design along with 5 checks. Uniform spacing of 90 x 20 cm and all standard cultural treatments were adopted. In each entry, 10 plants were randomly selected and observations were recorded for 15 characters *viz,* plant height (cm), monopodia/ plant, sympodia and sympodial length at 50 per cent plant height (cm), nodes/plant, inter boll distance (cm), stem dia (cm), seeds/boll, seed index(g), lint index(g), GOT(%), halo length(mm), boll weight(g), bolls/plant and seed cotton yield (g/plant). Correlation coefficients among different characters were worked out. Phenotypic correlation coefficients were further apportioned into direct and indirect effects by path analysis.

Phenotypic correlation : The pattern of association assumes significance when formulating selection strategies. Yield in any genotype, is a function of number of characters. The genetic correlation (r_g) among traits having less environmental influence is often used to assess the consequences of selecting for one or more characters. Hence, association analysis was done for seed cotton yield with 14 other yield components and also among themselves

(Table 3).

In this study, plant height exhibited negative correlation with seed cotton yield/plant. Yield improvement can be achieved if selection is practiced for shorter plant height. Similar reports on negative correlation between seed cotton yield/plant and plant height were made by Pradeep and Sumalini (2005) and Leelapratap *et al.,* 2007.Significant positive correlation was observed between monopodia/plant and seed cotton yield/plant. Similar results were obtained by Annapurve *et al.,* (2007). Sympodia/plant revealed strong negative correlation with seed cotton yield/plant. These results were in concurrence with the findings of Muthuswamy and Vivekanandan(2004). Sympodial length at 50 per cent plant height revealed negative correlation with seed cotton yield/plant. Nodes/plant also had negative correlation with seed cotton yield. Selection against these traits will help to improve the yield. Inter boll distance expressed positive and significant correlation with seed cotton yield/plant. Significant positive correlation was observed. Stem dia also revealed positive and significant correlation with seed cotton yield. However, there were no reports correlating these two traits.

Bolls/plant showed significant positive correlation with seed cotton yield/plant. Yield improvement can be achieved if selection is practiced for these characters. Similar reports were made by Muthuswamy and Vivekanandan (2004) and Leelapratap *et al.,* (2007). Boll weight revealed significant positive correlation with seed cotton yield/plant. Similar results of association of boll weight with seed cotton yield/plant were made by Muthuswamy and Vivekanandan (2004) and Leelapratap *et al.,* (2007). Seeds/boll was positively correlated with seed cotton yield. Similar reports were made by Annapurve *et al.,* (2007) and Leelapratap *et al.,* (2007). Seed index had negative correlation with seed cotton yield. Similar results were reported by Leelapratap *et al.,* (2007).

Lint index recorded strong positive association with seed cotton yield/plant. Similar results of significant correlation between lint index and seed cotton yield were reported by Naquib Ullah *et al.,* (2010). Ginning outturn expressed positive significant correlation with seed cotton yield/plant. Similar observation of positive significant correlation between seed cotton yield and ginning outturn was made by Annapurve *et al., (*2007), Leelapratap *et al.,* (2007) and Naquib Ullah *et al.,* (2010). The association between halo length and seed cotton yield/plant was observed to be significantly negative. Association analysis across genotypes revealed highly significant positive correlation for seed cotton yield/plant with bolls/plant, boll weight, monopodia, interboll distance, stem dia, lint index, ginning outturn whereas halo length,

Table 1. Hybrids and their performance features across the three cotton growing zones of India during 2005-2006 and the salient features of the check varieties

Hybrid	North Zone (6 locations)				Central Zone (7 locations)				South Zone (6 locations)			
	Seed cotton yield (kg/ha)	Fibre length (mm)	Fibre strength (g/tex)	S:L ratio	Seed cotton yield (kg/ha)	Fibre length (mm)	Fibre strength (g/tex)	S:L ratio	Seed cotton yield (kg/ha)	Fibre length (mm)	Fibre strength (g/tex)	S:L ratio
GSHH 2201	1284	26.40	20.40	0.77	2060	26.90	21.40	0.80	2127	30.20	23.00	0.76
VBCH 2312	1669	30.30	21.90	0.72	1808	30.80	24.10	0.78	1988	29.70	24.40	0.82
CHATRAPATHI	1148	33.10	25.70	0.78	1977	33.30	25.40	0.76	1882	32.80	22.90	0.70
BCHH 1232	1430	31.30	22.20	0.71	2046	29.80	22.70	0.76	2235	32.00	22.50	0.70
JKCH 2022	1228	29.60	22.10	0.75	2103	31.10	22.80	0.73	2709	32.10	22.80	0.71
RATNA	1265	29.70	20.60	0.69	1970	32.70	24.00	0.73	2056	29.50	24.50	0.83

Salient features of Checks

H 10	Long staple variety, suitable for rainfed conditions
SAHANA	Tolerant to bollworm, suitable for irrigated or rainfed conditions
RAH 100	High boll number, medium sized bolls suitable for irrigated conditions
RAH 221	High boll number, has good combining ability, suited for rainfed conditions
GSHV 01	Good performance in central zone and south zone of India , suitable for irrigation and conditions

Table 2. Genotypes derived from double and single cross hybrids included for evaluation at ARS, Dharwad

Entry No	F_4 progeny of cross	Progenies		Entry No	F_4 progeny of cross	Progenies	
Double cross hybrids				**Single cross hybrids**			
DC 1.	GSHH 2201 × RATNA	10		DC 7	GSHH 2201	6	
DC 2.	VBCH 2312 × RATNA	3		DC 8	VBCH 2312	13	
DC 3.	CHATRAPATHI × RATNA	17	46	DC 9	CHATRAPATHI	9	
DC 4.	BCHH 1232 × RATNA	5		DC 10	BCHH 1232	8	62
DC 5.	JKCH 2022 × RATNA	11		DC 11	JKCH 2022	14	
Three-way cross hybrids							
DC 6.	RCR 4 x RATNA	7		DC 12	RATNA	12	

plant height, nodes, sympodial length at 50 per cent plant height showed significant negative correlation .

Path coefficient analysis : Path coefficient is a tool, which provides an effective measure of direct and indirect cause of association and depicts the importance of each factor involved in contributing towards yield. In order to obtain such developmental relations, the cause and effect relationship between seed cotton yield *per se* and yield components were studied in cotton through path coefficient analysis, the results are discussed below (Fig. 1).

Plant height had direct negative effect on seed cotton yield/plant (-0.0063). Plant height had higher indirect effect *via* boll weight (0.1187) and sympodia/plant (0.071). Earlier workers observed similar indirect effect of plant height on sympodia/plant. Positive direct effect of monopodia/plant on seed cotton yield/plant was

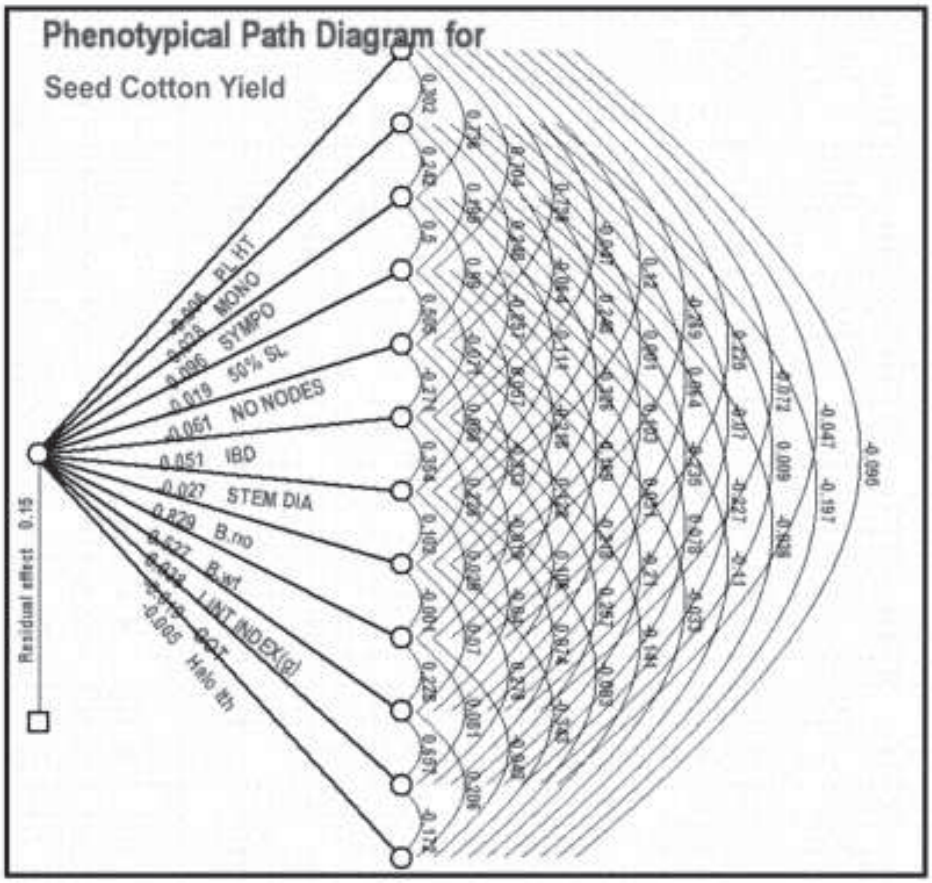

Fig. 1. Phenotypical path diagram for yield and yield contributing characters

Table 3. Phenotypic correlation among fifteen different characters in 115 genotypes of *Gossypium hirsutum* L. at ARS Dharwad during *kharif*, 2010-2011

Characters	Plant height PH	Mono-podia MP	Sym-podia SP	Sympodial length at 50 per cent plant height 50 per cent SL	Nodes NNP	Inter boll distance IBD	Stem diameter plant SD	Bolls weight BW	Boll/ boll BN	Seeds/ boll NSB	Seed index SI	Lint index LI	GOT length GOT	Halo cotton HL	Seed cotton yield SCY
PH	1	0.3019**	0.7359**	0.7037**	0.7358**	-0.0472	0.1199	-0.2692**	0.2251*	-0.1582	-0.0623	-0.0723	-0.0472	-0.0955	-0.0972*
MP		1	0.2420**	0.1948*	0.2479**	-0.0637	0.2485**	0.0011	0.0638	-0.0494	-0.0955	-0.0701	0.0091	-0.1969*	0.0528*
SP			1	0.4995**	0.9902**	-0.2567*	0.1108	-0.3262	0.1026	-0.1047	-0.1138	-0.2353*	-0.2274*	-0.0365	-0.2087*
50 per cent SL				1	0.5047**	-0.0706	0.0573	-0.2177*	0.1692	-0.1233	-0.0320	0.0305	0.0776	-0.1097	-0.0974*
NNP					1	-0.2709**	0.0857	-0.3330	0.1225	-0.0795	-0.1066	-0.2183*	-0.2104*	-0.0326	-0.2051*
IBD						1	0.3538**	0.2265*	-0.0193	0.0696	-0.1224	0.1057	0.2567**	-0.1410	0.2103*
SD							1	0.1020	0.0289	0.0643	-0.1311	-0.0405	0.0736	-0.0931	0.0985*
BW								1	-0.0010	0.1993*	-0.1758	0.0704	0.2763**	-0.3430**	0.8314*
BN									1	0.1091	0.2226*	0.2281*	0.0815	-0.0434	0.5314*
NSB										1	-0.0013	0.0860	0.1264	0.0199	0.2267
SI											1	0.6882**	-0.0810	0.4217**	-0.0137
LI												1	0.6567**	0.2056*	0.1986**
GOT													1	-0.1720	0.2801**
HL														1	-0.3096**
SCY															1

*=Significant at 5 per cent **= Significant at 1 per cent

Table 4. Direct and indirect effects of different characters on seed cotton yield/plant at phenotypic level in 115 genotypes derived from single and double cross hybrids of *Gossypium hirsutum* L. at ARS Dharwad during *kharif*, 2010-2011

Characters	Plant height (PH)	Mono-podia (MP)	Sym-podia (SP)	Sympodial length at 50 per cent plant height (50% SL)	Nodes (NP)	Inter boll distance (IBD)	Bolls/ plant (BP)	Boll weight (BW)	Stem diameter (SD)	Lint index (LI)	GOT (GOT)	Halo length (HL)	Correlation with seed cotton yield
PH	**-0.0063**	0.0084	0.071	-0.0136	-0.0451	-0.0024	-0.2232	0.1187	-0.0033	-0.0028	0.0009	0.0004	-0.0973
MP	-0.0019	**0.0277**	0.0233	-0.0038	-0.0152	-0.0032	0.0009	0.0336	-0.0068	-0.0027	-0.0002	0.0009	0.0526
SP	-0.0046	0.0067	**0.0965**	-0.0096	-0.0607	-0.013	-0.2705	0.0541	-0.0030	-0.009	0.0043	0.0002	-0.2086
50percentSL	-0.0044	0.0054	0.0482	**-0.0193**	-0.0309	-0.0036	-0.1806	0.0892	-0.0016	0.0012	-0.0015	0.0005	-0.0974
NP	-0.0046	0.0069	0.0955	-0.0097	**-0.0613**	-0.0138	-0.2762	0.0646	-0.0023	-0.0084	0.0040	0.0001	-0.2052
IBD	0.0003	-0.0018	-0.0248	0.0014	0.0166	**0.0508**	0.1878	-0.0102	-0.0096	0.0041	-0.0049	0.0006	0.2103
BP	-0.0008	0.0069	0.0107	-0.0011	-0.0052	0.018	**0.0846**	0.0152	-0.0272	-0.0016	-0.0014	0.0004	0.0985
BW	0.0017	0.0000	-0.0315	0.0042	0.0204	0.0115	0.8293	**-0.0005**	-0.0028	0.0027	-0.0053	0.0016	0.8313
SD	-0.0014	0.0018	0.0099	-0.0033	-0.0075	-0.001	-0.0009	0.5271	**-0.0008**	0.0088	-0.0016	0.0002	0.5313
LI	0.0005	-0.0019	-0.0227	-0.0006	0.0134	0.0054	0.0584	0.1202	0.0011	**0.0384**	-0.0125	-0.0009	0.1988
GOT	0.0003	0.0003	-0.0219	-0.0015	0.0129	0.0130	0.2292	0.0430	-0.0020	0.0252	**-0.0191**	0.0008	0.2802
HL	0.0006	-0.0055	-0.0035	0.0021	0.002	-0.0072	-0.2844	-0.0229	0.0025	0.0079	0.0033	**-0.0046**	-0.3097

Residual effect =0.1497

observed (0.0277). Further, monopodia/plant had higher indirect effect sympodia and boll weight. These results are in agreement with Muthu *et al.,* (2004). There was positive (0.0965) direct effect of sympodia/plant on yield. Selection based on this character would improve the seed cotton yield. Salahuddin, *et al.,* (2010) reported positive direct effect of sympodia/plant on seed cotton yield/plant. Sympodial length at 50 per cent plant height had a negative direct effect (-0.0193) on seed cotton yield/plant. It had the highest indirect effect *via* boll weight (0.0892) and sympodia (0.0482).

Nodes had negative direct effect on seed cotton yield (-0.0613). Inter boll distance exhibited positive direct effect on seed cotton yield/plant (0.0508). It had indirect effect *via* boll weight (0.0646). The direct effect of bolls/plant was found to be positive (0.0850). Hence, the contribution of bolls/plant towards the seed cotton yield/plant was positive (Table 4). Positive direct effect was reported by Leelapratap *et al.,* (2007). A positive direct effect of lint index on seed cotton yield/ plant was observed (0.0384). Similar direct effect was also reported by Leelapratap *et al.,* (2007). The trait, ginning outturn, had indirect and negative effect (-0.0191) on yield. These results were in agreement with Annapurve *et al.,* (2007) and Salahuddin *et al.,* (2010).

Path analysis revealed high positive direct effect of monopodia, sympodia, inter boll distance, boll and lint index on seed cotton yield. Selection based on these characters would improve seed cotton yield. However, differences in individual traits were observed for indirect effects on seed cotton yield/plant. Highly negative direct effect on seed cotton yield/plant was observed for plant height , sympodial length at 50 per cent plant height, nodes, boll weight, stem dia, ginning outturn and halo length.

REFERENCES

Annapurve, S.N., Deshmukh, G.S., Kausale, S.P. and Kale, U.V. 2007. Correlation study of yield contributing characters in American cotton. *J. Cotton Res. Dev.,* **21** : 16-20.

Leelapratap, K., Chengareddy, V., Romekumar, P.V. and Srinivasa Rao, V. 2007. Association and path analysis in American cotton (*Gossypium hirsutum* L.). *The Andhra Agric.,* **54**: 31-35.

Muthu, R., Kandasamy, G. and Jayaramachandran, M., 2004. Correlation and path coefficient analysis for yield and fibre quality traits in cotton (*G. hirsutum* L.). *J. Indian Soc. Cotton Improv.,* **29**: 17-20.

Muthuswamy, A. and Vivekanandan, P. 2004. Correlation studies on seed cotton yield and its components in cotton (*G. hirsutum* L.). *J. Indian Soc. Cotton Improv.,* **29**: 7-9.

Naquib Ullah Kham, Gul Hassan and Raziuddin, 2010. Genetic aptitude and correlation studies in *Gossypium hirsutum* L. *Pak. J. Bot.,* **43** : 2011-17.

Pradeep, T. and Sumalini, K., 2005. Studies on performance of genetic variability for plant type and productive traits in multiple crosses of cotton (*Gossypium hirsutum* L.). *J. Indian Soc. Cotton Improv.,* **30** : 59-66.

Salahuddin, S., Abro, S., Kandhro, M. M., Salahuddin, L. and Laghari, S. 2010. Correlation and path coefficient analysis of yield components of upland cotton (*Gossypium hirsutum* L.). *World Appl. Sci. J.,* **8** : 71-75.

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